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A METHOD OF MOUNTING AND MEASURING THE LOCATION OF A 9 ACCELEROMETER PACKAGE ON CADAVERIC SPECIMENS

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INTRODUCTION

The purpose of this paper is to describe the procedure that has been developed to accurately locate, position, and mount electronic instrumentation on the skull of a cadaveric specimen relative to a known anatomic landmark and with minimal damage to the anatomic structure. Specifically the procedure described is the mounting of the 9 accelerometer instrumentation package developed by Wayne State University to the top of the head so that the three axes are parallel to the axes of a coordinate system defined by a plane formed by the centers of the external auditory meatus (auricular points) and the inferior orbital crests. This plane is referred to as Reade's plane.⁽¹⁾ The origin of the coordinate system is located at the midpoint of a line between the external auditory meatus. The positioning of the accelerometer package so that all three axes are parallel to the prime coordinate system greatly simplifies subsequent data reduction.

The instrument used in this procedure is a specially designed stereotaxic device. The basic stereotaxic device is a neurologic research tool that has been used in research with animals to accurately measure locations within the brain and related structures. The stereotaxic device as designed for our research rigidly mounts to the head using the inferior orbital crests and the external auditory meatus to form an external work surface within Reade's plane. From this surface the accelerometer mount can be accurately positioned on the skull and measured within ± 1 millimeter at the desired location.

(1) Becker, Edward B., "Measurement of Mass Distribution Parameters of Anatomical Segments", 16th Stapp Car Crash Conference, 160-185, 1972.

PROCEDURE

A specially designed stereotaxic unit was obtained from David Kopf Industries⁽²⁾. Devices such as this stereotaxic device are normally not used in human research since the usual animal experimental units are not wide enough along the Y axis to accommodate the human skull. A device similar to this, however, was utilized by Becker⁽¹⁾ in measuring distribution of mass parameters in anatomical segments. Two Kopf micromanipulators were also obtained. One is utilized for holding the accelerometer mounting plate during fixation, and the second is used for recording the mounting plate position following fixation relative to the system origin. Figure 1 shows two views of the stereotaxic device with the mounting plate attached to the micromanipulator.

The specimen is placed on a table in the prone position with the head extended past the end of the table. The stereotaxic device is held vertical by an adjustable floor stand. One end of each ear bar is placed into the external auditory meatus. The other end is placed in the mounting jig on the stereotaxic frame. Both bars are moved laterally (+Y) until the head is centered according to markings on the ear bars and within the main arms of the stereotaxic device. The eye mounting bars are then engaged upon the inferior orbital crests and held firmly against these mounting bars by opposing pressure with a chin restraint.

Using a specially modified micromanipulator, the mounting base for the 9 accelerometer mount is lowered against the scalp. Design and placement of the micromanipulator is such that the mounting base is precisely positioned so that the X and Y axes of the accelerometer package are parallel to the X and Y axes located in Reade's plane.

With the mounting plate held in position, the locations for the mounting bolts are marked on the scalp. The micromanipulator with mounting base is then removed. Incisions are made through the skull, and undercut slots are cut through the outer bone into the diploë layer of the skull. Specially designed T-shape mounting bolts similar to those used by John Melvin at HSRI were made

(2) David Kopf Instrument Company, Tujunga, California.

to place into these mounting slots. The micromanipulator (with base plate still attached) is then repositioned over the skull and lowered down until skull contact is achieved. The T-shape mounting bolts are inserted and rotated to lock into position. Dental acrylic is used to cement the T-bolts in place as well as to fill any irregularities between the curved base plate and the skull. The dental acrylic is cured for approximately 10 to 15 minutes. Following curing, the micromanipulator is detached from the accelerometer base plate and removed from the stereotaxic frame.

The second or measurement micromanipulator is then used to measure the spatial location of three marked points on the surface of the base plate mount. Zero position is checked continuously against a calibrated AP zero bar (Kopf Instruments). The measurements of these three points on the base plate describe the location of the accelerometer base plate. The subject is then removed from the stereotaxic device.

Following transport of the specimen to the experimental impact location, the 9 accelerometer mount is attached to the mounting base plate.

DISCUSSION

The above described procedure has been found to be a straightforward method of accurately and firmly affixing the 9 accelerometer mount to the skull of the specimen without destroying the integrity of the cranial vault. No difficulty has been found in the placement or measurement of the accelerometer mount on the head of anatomic specimens using the stereotaxic device. Typically, errors in the desired orthogonal location in any axes were of less than 1 degree.

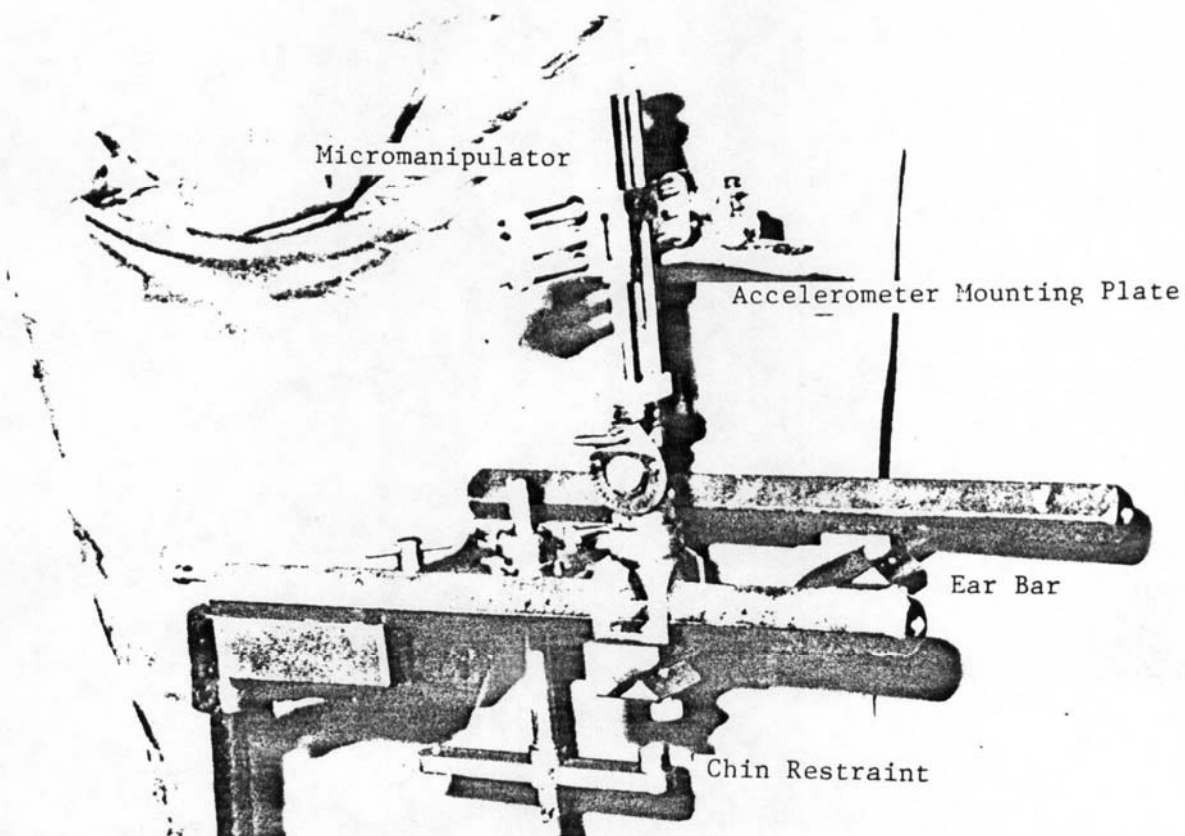
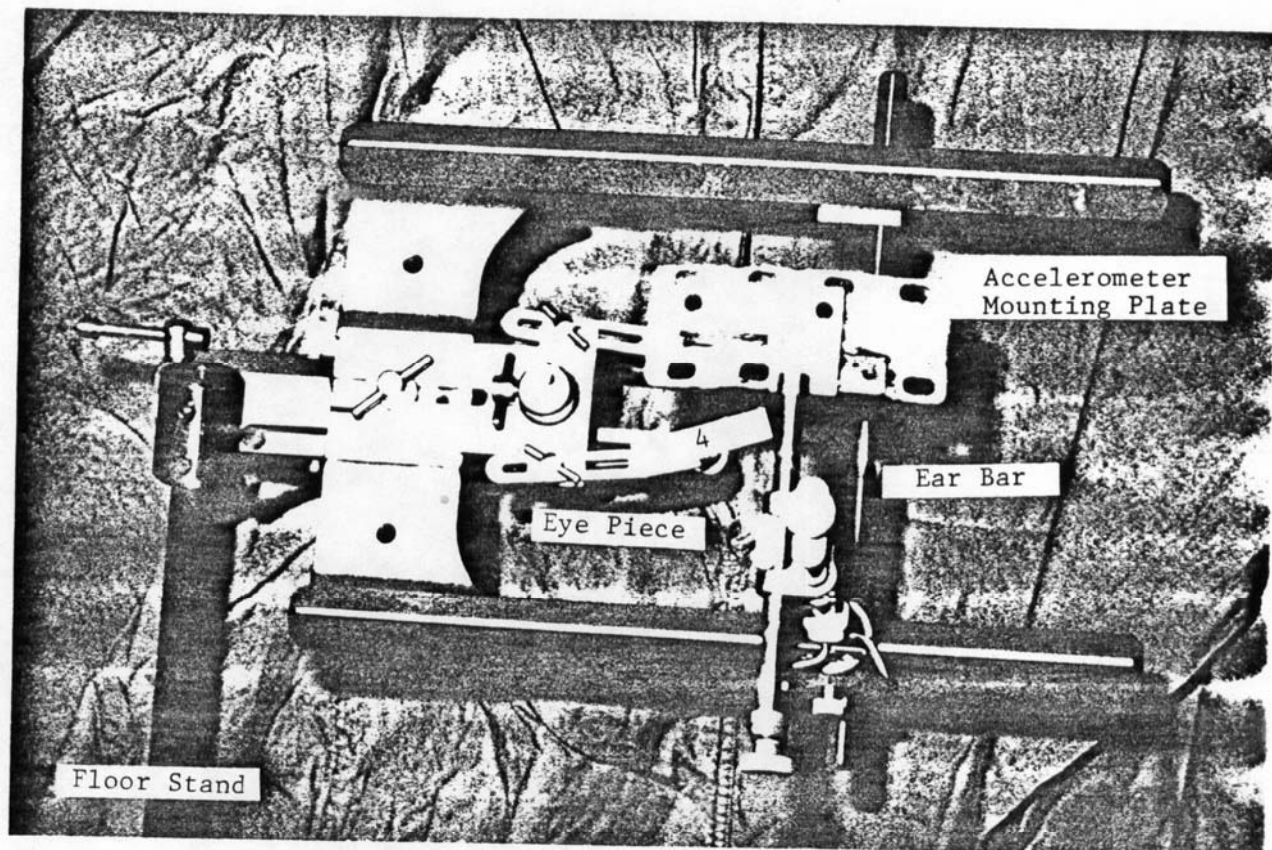


FIGURE 1. TWO VIEWS OF THE STEREOTAXIC DEVICE USED FOR POSITIONING THE HEAD ACCELEROMETER MOUNTING PLATE